M.R.O. 1—77,000—8-6-37.

(1) Number of pages 45 60

(2) Date of repair

(3) Initials of the Referencer

MADRAS RECORD OFFICE.

Government of Madras.

Public works DEPARTMENT.

G.O. No. 3763	Press ~~Mis.~~
580-31	
Dated 26 11	1869.

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69

Read the following papers :—

No. 530. Endorsement of the Officiating Superintending Engineer, 8th Division, dated Chinnamanoor, 18th October 1869, No. 1,648.

No. 56.

Memorandum on work executed in connexion with the Perryaur Project up to 30th September 1869.

A SIX-FOOT path has been cut from the water-shed to a distance of four-and-a-quarter miles towards Cumbum, and of about two-and-a-quarter towards the Perryaur. For a mile and a half of this distance the earthwork has been completed to the full width of eighteen feet.

2. A portion of the basin of the lake has been surveyed.

3. The health of the workmen continues good, and there has been no difficulty with regard to the supply of labour.

4. The rainfall during the month has been 5·47 inches and 6·24 inches at the two camps, and the total discharge of the river during the month has been 67·424 millions of cubic yards, giving a depth run off from the whole drainage area of 3·13 inches. These figures are somewhat less than Captain Ryves' estimate.*

	Inches.
* Rainfall	6·03
Discharge of river, 80 millions of cubic yards depth run off...	3·72

A table and diagram of rainfall, river level, and discharge are enclosed.

CAMP PERRYAUR, 2nd *October* 1869. (Signed) J. PENNYCUICK, Lieut., R. E., *Executive Engineer, on Special Duty.*

One Diagram.

FORWARDED to the Chief Engineer for Irrigation.

(Signed) H. L. PRENDERGAST, Captain, R. E., *Offg. Supg. Engineer,* 8*th Division.*

No. 289.

Note by the Acting Chief Engineer for Irrigation.

THE result of the visit which I have just made to the Perryaur is to modify considerably the idea which I had formed* from the reports which were then available of the circumstances of this project, and of the amount of information still needed in order to allow of the final designs being drawn out and their cost estimated.

* Memorandum, dated 15th June last. Proceedings of the Madras Government, dated 28th July 1869, No. 2,466.

2. The site selected for the bund is at a short distance below the junction of the Perryaur and the Peria Muliayaur, and is near the head of a deep pool which extends for a distance of about one-and-a-half or two miles down the river. There is rock at a depth of seven or eight feet below datum near the left bank, and, indeed, the datum is on a block or mass above the general level of the bed. The bed near the right bank is, however, of gravel and coarse sand, and on making a cutting into the bank it was found that this consists of layers of sand, gravel, and soil deposited by the river, and it is not at present known at what level the rock, which no doubt will be found below, will be reached. Pits will be at once sunk to

ascertain this, and it is proposed to trace the rock from these pits to the river should rock be met with within the useful limits of level, which may be taken to be from six feet below to three or four feet above datum.

3. In paragraph 9 of the Memorandum given in the Government Order above referred to, I suggested that the river water during the construction of the bund to the level* of the first saddle should be passed under a culvert of suitable dimensions, having its sill about three feet above datum, in order that the work might not be liable to too frequent interruption. In a letter† of earlier date but received subsequently, Lieutenant Pennycuick proposed as a preferable arrangement the placing the culvert in the bed of the river so as to occupy about one-half of the width of the latter. It is, however, quite clear to me that to do so would be attended with much difficulty, for the formation of the requisite longitudinal and cross bunds in the river would be no easy task; to make them water-tight or sufficiently so when founded upon gravel would be impracticable; the river is too narrow to admit of half its width being closed to the freshes without danger to the bunds, and, lastly, no material advantage would result from such an arrangement. Within the limits indicated at the end of the preceding paragraph it does not practically matter at what level the culvert sill is placed. Should, therefore, the excavations meet with rock at or near those limits, the culvert should be built, if on a high level, as near the river as possible, and, if on a low level, at the nearest site at which the clay may be found going down to the rock, for, if the foundations be much below water-level and there be no water-tight soil between the excavation and the river, a considerable expense would be incurred for baling, and the work would not get on as fast, or be as good, as if built in a dry excavation.

* 109·64.

† No. 31, of 22nd June.
Superintending Engineer's No. 1,016 of 13th July.

4. It appears to have been supposed that rock would be met with generally within a short distance of the surface of the hills, and especially at the first saddle (109·64) chosen by Captain Ryves for the escape weir. Such, however, is not found to be the case, for there is certainly no rock above 89, and, as far as can be judged, none for several feet below this level. This circumstance appears to render it clear that an escape cannot be economically constructed at this saddle, for the expense of passing surplus water over an escape 60 or 70 feet high would be excessive. There is a second saddle at 168, at which it has been proposed to make the escape for all higher levels of normal lake surface than 140 or 145. Here it is believed that rock has been reached at about 140 to 145, but until the excavations shall be more advanced it will not be certain whether solid rock or only a boulder has been struck. Here a long trench has been opened transversely to the saddle, and Lieutenant Pennycuick has been instructed to carry it down until the surface of the rock can be traced for a length sufficient for the purposes of an escape. With normal lake surface at 150 the level of the crest of an escape would be 160, and, provided solid rock be reached at any level above 135, this saddle will do for the site of the escape.

5. The absence of rock near the surface at these saddles on the left bank of the river led to an examination of the right bank, where, at about 200 in the line

(continued) of the bund, is a short saddle, which may perhaps be made use of either for the whole or a part of the discharge. This will be at once carefully examined.

6. At present the survey of the Perryaur has been carried to only a short distance below the site for the bund already selected; but it will be advisable to carry on the survey down to the small river which falls in on the right bank just to the west of Nellicumputty Tavalum, and similarly the ground for some distance to the north of the Perryaur should be examined in order that the levels of the hills and saddles may be ascertained. As the case now stands it is by no means quite certain that the site selected for the bund is the only, or the best, one available, and it is of importance that all the information requisite for a correct decision should be obtained, and, as the limits within which a possible site may exist are very small, the investigation will not occupy much time. The hills run close to the river for about two or two-and-a-half miles, after which they turn off to the north and south, and the character of the country changes materially. I found one other possible bund site about one-and-a-half miles west of the Perryaur camp, and, as far as I could judge, this is the only alternative one, but in any case it is requisite that the exact circumstances of the Perryaur and of the hills close to it should be ascertained. The elephant-grass makes it very difficult to get clear views of the ground or to penetrate to any point without first cutting a pathway. Lieutenant Pennycuick and myself went down the river on a raft for a couple of miles or so; but we were then stopped by the rocks, and, after walking along the north bank for about a mile, we found it impracticable to penetrate further down through the long grass. The bed of the river below the deep pool is certainly solid rock right across for considerable distances at any rate, and it is clear that the bed is considerably higher at some parts lower down than it is at the bund site above.

7. I have asked Lieutenant Pennycuick to ascertain, as early as may be, the relative levels of the water when the river is low and at various heights at the bund site and at head of the first rapid lower down, this information being necessary in order to calculate the discharge through a culvert, as well as to determine the velocity with which water in high freshes would pass through an opening were such left in the bund above the culvert.

8. In an estimate, shown in abstract in his letter of the 22nd June, Lieutenant Pennycuick allowed 8 annas a cubic yard for the earth-work of the bund, but he now considers that this rate is insufficient, this opinion being based on the road-work done during the present season. He informs me that the cutting of the eighteen-feet roadway has cost, on an average, (exclusive of rock,) 8 annas a cubic yard, and I have had places pointed out, where the soil was moderately easy, which had cost this rate. There can be no doubt that were 8 annas a proper rate for this moderately easy soil with a lead of not more than ten or twelve yards, a very much higher rate would be required for the cheapest yard of the bund. Without in any way at present indicating the proper rate for the bund, to do which I have not yet got the requisite data, I may say that I consider the cost of the road-work much too high, and I am convinced that it is capable of being materially lowered. It is my impression that in the low country the moderately easy soil to which I have referred could within a lead of twenty yards be placed on a tank-bund for 1 anna a cubic yard, the rate of pay for a cooly being 2 annas: at the Perryaur

road-works the cooly hire is 8 annas, and the corresponding cost would, therefore, be 4 annas. It is not difficult, I think, to account for this latter rate having been found in practice doubled. In the first place, the coolies do not leave the Chinnamullay camp before 8, and they return about 5. For some of the work they have to walk long distances, and some small gangs have certainly not done more than four or five hours' work in the day. Again, the tools are not always well adapted to the work to be done, while many of the coolies are not able-bodied men at all. It has been considered desirable not to discourage those who have been willing to come to work by rejecting any of those who presented themselves, or by exacting any thing approaching to a full day's work. With the exception of a few men who have been hutted at the Perryaur camp, all the coolies have lived at Chinnamullay, and this has not been convenient, though perhaps it was not easy at first to make other arrangements. The men being without their wives or families have had to cook their own rice, and time morning and evening has been allowed for this. I may add, too, that Lieutenant Pennycuick and the officers with him have had their time much occupied in surveying and levelling, and have not been able, therefore, personally to look strictly after the coolies while at work. It is perhaps hardly necessary to attach much weight to the fact that many of the men have not been accustomed to such work. Difficulties of this kind have always to be overcome, and hereafter there will be at least as large a proportion of the thousands, as there are now of the hundreds, who will need to be taught how to work.

9. So far as the past is concerned I do not attach much importance to the comparatively small amount of work executed for the money spent on the road, but it appears to me that for the future considerable changes need to be introduced. In the first place, the rate of pay appears to be unnecessarily high. The climate for seven to eight months in the year is healthy, so far as may be judged from the experience of the last two seasons; the works are not far from the plains; food is cheap, for rice is eight measures* a rupee, at Cumbum, and at the works, its cost, including the curry-stuff thereto belonging, is 3 annas a measure. I find that carts in the Cumbum Valley and in all the neighbouring parts of the Madura district are obtainable for 1½ annas a mile. Apparently the ordinary wages of a cooly are 4 annas a day, and I am, therefore, disposed to think that 7 annas are the most that should be paid at the Perryaur to thoroughly able-bodied men who might be placed in the first-class, and 6 annas to less able men who would form the second-class. The only coolies who should receive higher pay would be those employed in jumping holes for blasting, and 8 annas should suffice for these. The above rates appear to me to be fully as high as would be admissible, and I am not at all sure that 6 annas would not be enough for a first-class cooly employed on ordinary work, for the Perryaur is not now the *terra incognita* that it was two years ago. The labourers employed will be provided with huts, and I should recommend two woollen cumblies to be served out to each cooly, one for use out of doors and the other at night.

* This is supposed to be about the average, but on the 16th October forty-eight measures of paddy were obtainable for Rupees 2-3-6.

10. As soon as Lieutenant Pennycuick can find time for the purpose he should introduce task-work, the task being based upon the quantity of work done by a gang

of twenty or thirty men in (say,) nine hours when provided with thoroughly efficient tools, and superintended by himself or by one of his Assistants. The proper cost of earthwork in various soils, of jumping holes for blasting, of rivetment building, etc., and indeed of all sorts of work which can be accurately measured, should thus be determined, and then, whatever uncertainty there may be as to the daily earnings which will attract labourers, there will be little or none as to the quantity of work which should be expected from a given number of men.

11. When the time comes for the commencement of the dam across the river and of the cutting through the ridge, the bulk of the labour will be concentrated in two camps, one near the ridge and the other near the Perryaur. There is such an abundance of long grass, bamboo and jungle-wood, and these materials make such excellent and comfortable dwellings, that notwithstanding some drawbacks, the huts for the coolies should, I think, be therewith made. To prevent, however, extensive conflagrations, the huts should be in groups of not more than four to six sheds at one place: the cooking place for each group should be at some little distance, and its walls should be of wattle and dab, and the side of the roof over the fires should be lined with bamboo mat plastered with mud. The provision of latrines (earth-trenches) should be looked to, and the sites should be filled in from time to time, and other ground should be taken up. Strict discipline will be necessary and must be steadily enforced in all the camps, and all the arrangements should be carried out according to rule.

12. With regard to the provision of labour for the works, the plan which I think will probably work best is to make use of the more intelligent of the coolies who have worked during the last two seasons to collect whatever labour may be required in gangs of from thirty to forty each. The man thus collecting the labour would be the maistry of the gang, and he might receive 3 pies or $2\frac{1}{2}$ pies per head as remuneration for the number of coolies of the first or second class, respectively, brought to, and maintained on, the works by him. Each gang should then have its own huts, and the maistry would be looked to to see that all orders, whether relating to discipline or work, were carried out, and the supervising officers would be relieved of much trouble by having only one man instead of thirty or forty to deal with. Some inducement would have to be offered to coolies in the first place to come up, and perhaps five days, pay* on arrival, to compensate for the expenses of the journey, etc., would suffice. Each cooly maistry should be provided with printed memoranda of the terms or rates he would be empowered to offer. It is intended that all money earned by the gang should be paid to the maistry; this should be done in the presence of as many of the gang as might choose to attend, and, as the maistry would inevitably take some per-centage out of it, the gang should have a remedy by having the option of deposing him if he failed to distribute the earnings fairly.

* In addition to huts, cumblies, and Commissariat arrangements so as to prevent grain becoming unfairly expensive.

13. I have touched upon the above details, because upon them, or upon efficient substitutes for the arrangements sketched out, will depend, in a great measure, the progress and the cost of the work, and whatever system may be adopted should be prepared in detail beforehand, so that there may be no waste of time or money.

14. The information gained during the recent visit to the Perryaur has convinced me of the importance of the use of water for the excavation, transport, and deposit of soil for an earthen bund to the greatest extent practicable. The circumstances are not as favourable as I could wish for the silting process, for on the right bank there is no soil on a high level close to the bund site: the only considerable streams of water falling into the Perryaur above the site are cut off by a deep ravine, requiring a very long channel to turn it or a lofty aqueduct to carry water across in a more direct line. I think nevertheless a small supply may be obtained from the ravine, and that this may be supplemented to some extent from the Chinna Muliyaur or Survelaur. Four or five miles to the west of the Perryaur camp the Nellicumputty stream will afford an excellent supply, and it may possibly be brought to the work on a higher level than those from the north-eastward. Lieutenant Pennycuick thinks that some water may be got on the left bank of the Perryaur about two or three miles above the bund site; and, if so, this will be a great advantage, especially if it can be carried on a high level, for the hills on that side reach a great elevation, and water on a high level there could be used at a great advantage. It seems probable also that streams will be found round the hills to the south-west, and I have asked Lieutenant Pennycuick to explore in that direction. If possible, twenty to twenty-five cubic feet a second should be arranged for, and, if this quantity can be obtained from various sources, even though the levels of the greater part should be lower than would be convenient, a very satisfactory progress will be ensured. All likely streams should be gauged, so that the amount of work which they may be expected to do may be determined. There is plenty of soil on the hills on all sides, and water will excavate all which can be conveniently commanded by the silting streams; the rest will have to be done in the ordinary manner, though it may be hoped that at least the lower half of the bund will be found capable of being silted in. Should this not prove to be the case at the present site, it may be advisable to adopt another position, if one more favourably circumstanced can be found; or, on the other hand, it may be found necessary to abandon the idea of an earthen dam and to substitute one of masonry, except for the flanks; and, in that case, a site lower down the river, where the bed is peculiarly favourable for such a work, would in all probability be chosen.

15. Some reasons in favour of a high normal lake level have already been adduced. There is, however, another one, and that is that the execution of the ridge cutting with its sill lower than the junction of the Chinna Muliyaur and Survelaur would be very difficult owing to the considerable quantity of water which the former always contains: above that point there is only a comparatively small stream, the Survelaur, and this can be diverted above the side of the cutting, and indeed the water may be carried to the ravine near the bund site and thence to the bund. The 150 feet level for the lake will answer very well as regards this requirement, and indeed anything above 130 would avoid this difficulty.

16. It will be necessary to construct a regulating sluice at the cutting to restrict the discharge into the Sooroolyaur to a certain maximum,* as also to allow of the regulation of the discharge when that river is in heavy fresh from the drainage of its own catchment basin. The regulating work will be simple, and its cost trifling. This arrangement appears to me

* 750,000 cubic yards an hour was the quantity fixed by Captain Ryves, but it is possible that this may need modification.

preferable to that of a regulating reservoir below the cut, because at the reservoir a regulating sluice would be equally necessary, and it will be simpler and less expensive to allow only the maximum arranged for to pass through the ridge cutting, while it will be equally easy to provide at the latter for the diminution of the supply whenever the Soorooly may be in flood.

17. This is the first season during which the discharge of the Perryaur has been gauged, and the result has been to show a much smaller discharge than was anticipated by Captain Ryves, who had nothing but the recorded rainfall at certain stations at a considerable distance on which to base an estimate. It is supposed that the rainfall on the basin of the Perryaur has been less than usual, and whether this be the case can be indirectly ascertained by obtaining information of the actual rainfall of the year at the several stations mentioned by Captain Ryves and comparing the record with the averages which he gives. The differences between the assumed discharge in each month and the actual discharge of this season are shown below :—

	Captain Ryves' estimate. Millions of cubic yards.	As gauged in 1869. Millions of cubic yards.
July	170·00	89·672
August	120·00	102·066
September	80·00	67·424

18. The work in the shape of investigation remaining to be done on the hills is as follows. Lieutenants Pennycuick, Christie, and Greer will, it is expected, be able to complete this work by the end of this season, *i. e.*, by the middle of February next :—

1st.—The completion of the examination of the second (168 feet) saddle, so as to ascertain accurately the position of solid rock. At the first saddle (109·64) it is not worth while to incur any further expense, as the rock is there on too low a level for the saddle to be used as the site of either a permanent or temporary escape.

2nd.—The lie of the rock at the bund site should be accurately ascertained, and more particularly so on the right bank, as there the culvert will have to be constructed if this site be adhered to. At the same time the distance to which the river deposit on this side extends will be ascertained, and the quantity of soil to be removed, in order to make a water-tight junction between the hill and the bund, can then be calculated.

3rd.—The composition of the small saddle at about 200 on the left bank has to be examined, in order to see whether an escape can there be economically constructed.

4th.—The examination of the ground from which suitable soil will be obtainable should be continued, with especial reference to the requirements of the upper half of the bund. It may here be mentioned that, should the formation of an earthen bund without the aid of water ever be attempted, tramways will have to be laid down, and the work must then be so laid out that the trains for successive vertical portions of the dam may find soil so far above the level of the work under execution as to admit of an incline towards the bund. Also, should the lower part of the bund only be formed by silting, conveniently-situated soil should be reserved for the upper part.

5th.—The survey of the Perryaur has to be continued westwards, *i. e.*, down the river as far as the junction of the Nellicumputty Tavalum stream. A full cross section of the river and of the ground on either side is required at the spur (right bank) about one-and-a-half-miles from the Perryaur camp, which is just at the western extremity of Major Payne's survey. Cross sections should likewise be taken at any other points at which the hills may be found to be in any degree favourable for a bund site.

6th.—A gauge is required immediately above the first rapid below the Perryaur camp, and the level of the bed there, with reference to datum, having been scertained, the water-level in freshes of various heights should be compared with the gauge near the camp.

7th.—The country to the north of the Perryaur, west of Major Payne's survey, and east of the Nellicumputty stream, requires to be surveyed, and the levels of the hills and saddles, etc., fixed.

8th.—The Nellicumputty stream should be surveyed, and it should be ascertained on what line and at what level its waters can be brought to the bund site. When work in this direction is going on, a small camp should be formed at the Tavalum, where there is a considerable clearing.

9th.—The survey of the Perryaur above the bund site which is now in progress will bring to notice all the streams falling in on the left bank, and these should be explored so that it may be known how far they can be utilized.

10th.—The country on the left bank of the Perryaur behind the hills to the south-west should be examined. There in all probability (the Atlas sheet is here incomplete) some streams will be found, and, as the hills are high and continuous, possibly a high level supply may thence be obtained.

11th.—The several streams which it may appear to be feasible to bring to the bund should be gauged by making the discharge pass over planks with notches. Thus, for the Nellicumputty stream, the plank should have an opening of four feet by two feet with a clear overfall.

12th.—The nature of the rock in various localities near the bund site should be ascertained, so that the best place for quarries may be determined.

13th.—The various arrangements necessary for conveying stone and earth to the work should be put on paper.

14th.—There is still a good deal of work to be done in surveying and levelling the Perryaur and its tributaries above the bund site. The cross sections for determining the waterspread and contents at various levels may, in the first instance, be at about one-mile intervals, unless special circumstances should make more frequent sections advisable. It will be better to have complete levels at rather wide intervals than more detailed information for only a part of the basin.

15th.—Permanent bench-marks should not be lost sight of. These should be carefully selected or constructed, shown and numbered on the survey, and fully described in notes on the margin of the plans. Pegs have hitherto been largely used as bench-marks, but much more permanent marks are required, and there are plenty of rocks which may be readily made use of and so marked with a chisel as to be at once recognized.

19. No traces of line have been found on the hills, and it is probable, therefore, that this material will have to be obtained from the Cumbum Valley, where it is tolerably abundant. The nearest position from whence good nodular limestone can be obtained has yet to be ascertained, and afterwards the exact character of the line must be investigated as also its behaviour when mixed with the various clays obtainable near the Perryaur, and with which it will probably have to be incorporated in order to obtain good hydraulic mortar.

20. The roadwork has made good progress. The six-feet trace has been cut from the foot of the hills over the crest and thence to within a short distance of the Perryaur camp: 2,200 yards of the trace have been widened to eighteen feet, the full dimensions. A trace thirty feet wide has also been cut from the foot of the hills to Goodaloor. With the exception of a short length at a gradient of one in fourteen, the ruling gradient is one in fifteen. The line is generally an excellent one. The deep ravine near the Perryaur camp has necessitated the carrying of the trace far to the westward in order to keep the road on a high level. I think, however, that it will be advisable to make another and more direct line from the point where the ascending gradient, to carry the line over the saddle at the Hospital hill, commences, and thence to run a descending trace to cross the ravine by a timber (piers and superstructure) bridge. This line will be much shorter, and it will probably be of use for three or four seasons, during which the cartage of lime will be almost if not quite completed.

21. It does not appear to be advisable at present to continue the widening of the six-feet trace. To do this will cost a great deal of money, and there is no probability of this communication ever carrying any traffic but that connected with the Perryaur project works, which should, therefore, bear the cost. The trace will, therefore, be quite sufficient as a preliminary work; and if the rocks which here and there obstruct the path be blasted out, much greater facilities than at present exist for the transport of supplies will at once be provided. The only other work at present needed is the construction of catch-drains above the roadway to preserve the work already done.

22. Lieutenant Coaker has left the hills for the purpose of prosecuting the investigations connected with the distribution of the Perryaur water-supply in the low country. Considerable care will be required in dealing with the Soorooly irrigation. There are thirteen anicuts across this river, some of them excellent though irregular works, others which would require a considerable outlay to make them secure. None of them irrigate on both sides of the river, and some two or three are so close to others that it will be advisable to do away with several and to bring the irrigation under the higher dams. Before the requisite arrangements can be designed it is essential that reliable information as to the present water-supply at each anicut and in each channel should be obtained, and, as far as I have been able to find out, no registers have as yet been kept. This omission should, therefore, be remedied as early as possible.

23. On the admission of the Perryaur supply the water-level at each anicut will be raised considerably, the exact increase of head depending upon the length of each dam. The crests of the anicuts are at present of uneven level, and the proper course

appears to me to be to re-arrange them, so as to give as nearly as possible the same depth at the head of the channel with the minimum supply from the Perryaur (during the season of irrigation), the crests being made on a dead level from end to end. These channels will then never get less water than they do at present. To prevent, however, their receiving a greatly-increased supply, and to guard against damage, it will be necessary to provide all the channels connected with these anicuts with head-sluices, and these regulating works should have a width of opening equal to the mean width of the channels, and a height of vent sufficient to pass the maximum supply now carried by the channels below the surplus works, with which many of them are provided near their heads. Rules for the regulation of the sluices will have to be drawn up after the particulars of the present supply of the channels shall have been ascertained, and after the necessary modifications of the anicuts have been determined. The arrangements should be fixed on a scale sufficiently liberal to prevent any just cause of complaint on the part of the ryots interested, who have exhibited a commandable industry in the preparation of their lands for wet cultivation, and brought that cultivation in several places to a high state of efficiency. All the anicuts which it may be decided to retain should have carefully-fitted stone copings, and they should be otherwise strengthened where necessary, as the wear and tear which they will have to stand will be very much greater when freshes from the Perryaur come to be passed over them in considerable volume and during long periods.

24. The Perany and the Chittany on the Vygay are both admirable works, the former apparently of entire native design, while the latter would seem, from its having an ogee fall, to have been modified under European superintendence. Both require some little repair, the first to the crest, where of brickwork, and to the apron, which is a good deal displaced; the second needs the re-placement of a few of the stones on the rear slope (ogee), the re-packing of the rough-stone apron, and some additional rough-stone round the cut-stone apron of the under-sluices.

25. The general sketch of the proposed irrigation from the Vygay, given in Captain Ryves' letter of the 7th August 1867, appears to be sufficient for the present as a guide to Lieutenant Coaker in working out the details of the distribution channels required. Enough has not been done at present to enable an opinion to be formed of the probable cost of the works, and it may be doubted whether the investigations will be complete much before July 1870, as until February the officers on the hills will not be available to assist in pushing them forward. In the general sketch plan the channels are shown going into, and out of, the several tanks in succession. This arrangement should not be resorted to unless circumstances render it unavoidable. It is bad for the tanks, and it is unfair to the cultivators under the lower parts of the channels, who are unable to get water, however much their crops may be in need of it, until all the tanks above have been filled. Where this system has to be adopted the tanks should have low level sluices for the special purpose of passing on a portion of the supply.

MADURA,
28th October 1869.

(Signed) J. MULLINS, Major, R. E.,
Acting Chief Engineer for Irrigation.

Proceedings of the Madras Government, Public Works Department,
26th November 1869.

No. 531. ORDER THEREON, 26th November 1869, No. 3,763.

IRRIGATION, No. 28.

FROM this report the Government are disappointed to learn that much ha still to be done for the collection of information before properly complete plans and estimates can be prepared for the Perryaur diversion project. Four Officers of Engineers are occupied on the investigations, and the Government were in hopes that these investigations had been so far advanced as to have allowed of the scheme being put into shape for transmission to the Government of India in time for an allotment to be made for the work in the out-going Budget. This, it is now clear, cannot be done, and the work it is feared, will have to be delayed another year.

2. The work still requiring to be done above the ghaut is—

1st.—The fixing of the situation of the escape.

2nd.—The determination of the level and exact lie of the rock in the bed of the river at the site of the proposed dam.

3rd.—The ascertaining from whence suitable soil for the dam may be obtained, both with a view to the employment of the silting process and with reference to the requirements of the upper half of the bund in the event of silting being only partially available.

4th.—The completion of the survey of the river, with cross sections at proper intervals, and a final examination of the locality for the most favourable site. Also a survey of the country north of the Perryaur and east of the Nellicumputty stream for the purpose of fixing the levels of the hills and saddles, and determining the line by which the Nellicumputty stream may be brought to the site of the bund.

5th.—The examination of all the streams falling into the Perryaur on either bank, and the gauging of those which it may appear to be feasible to bring to the bund for silting purposes.

6th.—An examination of the nature of the rock in various places near the proposed bund, and the settlement of arrangements for the transport of stone and earth to the work.

3. Lieutenants Pennycuick, Greer, and Christie will, it is expected, be able to complete this work by the end of February, when the hills must be temporarily evacuated. There is a good deal to be done in the low country in surveying and levelling and in prosecuting investigations connected with the measures that will require to be adopted in re-arranging the system of irrigation both under the Sooroolyaur and the Vigay, to utilize the increased supply of water which will be available on the diversion into those streams of the Perryaur; but Lieutenant Coaker is actively engaged on the work, and, with the assistance of the other officers after February, Major Mullins expects that about July next sufficient will have been done to allow of a fair estimate being made out of the probable cost of the project.

4. The Government look with much interest to the fulfilment of these anticipations. They agree with Major Mullins in his remarks on the high rate for the ghaut work which Lieutenant Pennycuick has been paying, and they concur in

thinking that, with the better acquaintance the people will have formed with the country within the hills in consequence of the opening of the ghaut, the dread in which the locality is held will be greatly removed, and that it is not only possible but likely that labour will be obtainable at a rate considerably lower than that which it has been necessary hitherto to pay to attract workmen. For the present it does not appear to be necessary to complete the widening of the road-trace beyond the six-feet width to which it has been opened from the foot of the hills over the crest and to near the Perryaur camp. The Government have at present no funds at their disposal for this road, but it is under consideration in the Revenue Department whether an advance for the purpose may not be made from the local funds of the district.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R.E.,
Secretary to Government.

To the Superintending Engineer, 8th Division.
,, Chief Engineer for Irrigation.
,, Revenue Department.

No. 289.

Note by the Acting Chief Engineer for Irrigation

The result of the visit which I have just made to the Periyaur is to modify consider-ably the idea, which I had formed× from the reports which were then available, of the circum-stances of this project, and of the amount of information still needed in order to allow of the final designs being drawn out, and their cost estimated.

× Memorandum dated 15 June last Procdg 28 July 1869 No. 2466

2. The site selected for the bund is at a short distance below the junction of the Periyaur & the Peria Muliyaur, and is near the head of a deep pool which extends for a distance of about 1½ or 2 miles down the river. There is rock at a depth of 7 or 8 feet below datum near the left bank, & indeed the datum is on a block or mass above the general level of the bed. The bed near the right bank is however of gravel and coarse sand, and on making a cutting into the bank it

it was found that this consists of layers of sand, gravel, and soil deposited by the river, and it is not at present known at what level the rock, which no doubt will be found below, will be reached. Pits will be at once sunk to ascertain this, and it is proposed to trace the rock from these pits to the river, should rock be met with within the useful limits of level, which may be taken to be from 6 feet below, to 3 or 4 feet above datum.

3. In para 9 of the memorandum given in the Government Order above referred to, I suggested that the river water during the construction of the bund to the level of the first saddle should be passed under a culvert of suitable dimensions, having its sill about 3 feet above datum, in order that the work might not be liable to too frequent interruption. In a letter‡ of earlier date but received subsequently, Lieutenant Pennycuick proposed, as a preferable arrangement, the placing the culvert in the bed of the river so as to occupy about

× 109.64

‡ No. 31 of the 22nd June
Superintending Engineer No 1016 of the 13 July

about one half of the width of the latter. It is however quite clear to me that to do so would be attended with much difficulty, for the formation of the requisite longitudinal & cross bunds in the river would be no easy task; to make them water tight, or sufficiently so, when founded upon gravel would be impracticable; the river is too narrow to admit of half its width being closed to the freshes without danger to the bunds, and lastly no material advantage would result from such an arrangement. Within the limits indicated at the end of the preceding para:, it does not practically matter at what level the culvert sill is placed. Should therefore the excavations meet with rock at or near those limits, the culvert should be built, if on a high level, as near the river as possible; & if on a low level at the nearest site at which the clay may be found going down to the rock; for, if the foundations be much below water level, and there be no water-tight soil between the excavation & the river, a considerable expense

expense would be incurred for baling, & the work would not get on as fast or be as good as if built in a dry excavation.

4. It appears to have been supposed that rock would be met with generally within a short distance of the surface of the hills, and especially at the first saddle (109.64) chosen by Captain Pryce for the escape weir. Such however is not found to be the case - for there is certainly no rock above 89, and, as far as can be judged, none for several feet below this level. This circumstance appears to render it clear that an escape cannot be economically constructed at this saddle, for the expense of passing surplus water over an escape 60 or 70 feet high would be excessive. There is a second saddle at 168 at which it has been proposed to make the escape for all higher levels of normal lake surface than 140 or 145. Here it is believed that rock has been reached at about 140 to 145 but, until the excavations shall be more advanced, it will not be certain whether solid

solid rock, or only a boulder has been struck. Here a long trench has been opened transversely to the saddle, and Lieutenant Pennycuick has been instructed to carry it down until the surface of the rock can be traced for a length sufficient for the purposes of an escape. With normal lake surface at 150, the level of the crest of an escape would be 160, and provided solid rock be reached at any level above 135, this saddle will do for the site of the escape.

5 . The absence of rock near the surface at these saddles on the left bank of the river led to an examination of the right bank where, at about 200, in the line (continued) of the bund, is a short saddle, which may perhaps be made use of either for the whole, or a part, of the discharge. This will be at once carefully examined

6 . At present the survey of the Periyaur has been carried to only a short distance below the site for the bund already selected, but it will be advisable to carry on the survey down to

the

the small river which falls in on the right bank just to the west of Nellicumputty Tavalum, and similarly the ground for some distance to the North of the Peryaur should be examined in order that the levels of the hills and saddles may be ascertained. As the case now stands it is by no means quite certain that the site selected for the bund is the only, or the best, one available, and it is of importance that all the information requisite for a correct decision should be obtained; and, as the limits within which a possible site may exist are very small, the investigation will not occupy much time. The hills run close to the river for about 2 or 2½ miles, after which they turn off to the North & South and the character of the country changes materially. I found one other possible bund site about 1½ miles west of the Peryaur Camp, & as far as I could judge this is the only alternative one, but in any case it is requisite that the exact circumstances of the Peryaur & of the hills close

to

to it should be ascertained. The elephant grass makes it very difficult to get clear views of the ground, or to penetrate to any point without first cutting a pathway. Lieutenant Pennycuick & myself went down the river on a raft for a couple of miles or so, but we were then stopped by the rocks, and after walking along the North bank for about a mile we found it impracticable to penetrate further down through the long grass. The bed of the river below the deep pool is certainly solid rock right across, for considerable distances at any rate, and it is clear that the bed is considerably higher at some parts lower down, than it is at the bund site above.

7 I have asked Lieutenant Pennycuick to ascertain, as early as may be, the relative levels of the water, when the river is low, and at various heights, at the bund site and at head of the first rapid lower down, this information being necessary in order to calculate the discharge through a culvert, as well as to determine the velocity with which water in high freshes would pass through

through an opening, were such left in the bund above the culvert.

8. In an estimate, shown in abstract in his letter of the 22nd June, Lieutenant Pennyquick allowed 8 annas a cubic yard for the earthwork of the bund, but he now considers that this rate is insufficient, this opinion being based on the roadwork done during the present season. He informs me that the cutting of the 18 feet roadway has cost on an average (exclusive of rock) 8 annas a cubic yard, and I have had places pointed out, where the soil was moderately easy, which had cost this rate. There can be no doubt that were 8 annas a proper rate for this moderately easy soil, with a lead of not more than 10 or 12 yards, a very much higher rate would be required for the cheapest yard of the bund. Without in any way at present indicating the proper rate for the bund, to do which I have not yet got the requisite data, I may say that I consider the cost of the

roadwork

roadwork much too high, and I am convinced that it is capable of being materially lowered. It is my impression that in the low country the moderately easy soil, to which I have referred, could, within a lead of 20 yards be placed on a tank bund for 1 anna a cubic yard, the rate of pay for a cooly being 2 annas; at the Peryaur road works the cooly hire is 8 annas, and the corresponding cost would therefore be 4 annas. It is not difficult, I think, to account for this latter rate having been found in practice doubled. In the first place the coolies do not leave the Chinnamullay camp before 8, and they return about 5. For some of the work they have to walk long distances, and some small gangs have certainly not done more than 4 or 5 hours work in the day. Again the tools are not always well adapted to the work to be done, while many of the coolies are not able-bodied men at all. It has been considered desirable not to discourage those who have been willing to come to work by rejecting

any

any of those who presented themselves, or by exacting anything approaching to a full days work. With the exception of a few men who have been hutted at the Peryaur Camp, all the coolies have lived at Chinnamullay, and this has not been convenient, though perhaps it was not easy at first to make other arrange-ments. The men being without their wives or families have had to cook their own rice, & time morning & evening has been allowed for this. I may add too that Lieutenant Pennycuick & the officers with him have had their time much occupied in surveying & levelling, and have not been able therefore personally to look strictly after the coolies while at work. It is perhaps hardly necessary to attach much weight to the fact that many of the men have not been accustomed to such work. Difficulties of this kind have always to be overcome, & hereafter there will be at least as large a propotion of the thousands, as there are now of the hundreds, who

who will need to be taught how to work

9 So far as the past is concerned I do not attach much importance to the comparatively small amount of work executed for the money spent on the road, but it appears to me that for the future considerable changes need to be introduced. In the first place the rate of pay appears to be unnecessarily high. The climate for 7 to 8 months in the year is healthy, so far as it may be judged from the experience of the last 2 seasons; the works are not far from the plains; food is cheap, for rice is 8 measures a Rupee at Cumbum, and at the works its cost including the currystuff thereto belonging, is 3 annas a measure. I find that carts in the Cumbum Valley and in all the neighbouring parts of the Madura District are obtainable for 1½ annas a mile. Apparently the ordinary wages of a cooly are 4 annas a day, & I am therefore disposed to think that 7 annas are the most that should be

* this is supposed to be about the average, but on the 16 October, 48 measures of paddy were obtainable for Rupees 2-3-6.

be paid at the Peryaur to thoroughly able-bodied men who might be placed in the 1st Class, and 6 annas to less able men who would form the 2nd Class. The only coolies who should receive higher pay would be those employed in jumping holes for blasting, and 8 annas should suffice for these. The above rates appear to me to be fully as high as would be admissible, and I am not at all sure that 6 annas would not be enough for a 1st Class cooly employed on ordinary work, for the Peryaur is not now the terra incognita that it was 2 years ago. The labour employed will be provided with huts, & I should recommend 2 woollen cumblies to be served out to each cooly one for use out of doors, and the other at night.

10 As soon as Lieutenant Pennycuick can find time for the purpose, he should introduce task work, the task being based upon the quantity of work done by a gang of 20 or 30 men

men, in, say, 9 hours, when provided with thoroughly efficient tools, and superintended by himself or by one of his Assistants. The proper cost of earthwork in various soils, of jumping holes for blasting, of revetment building &c, and indeed of all sorts of work which can be accurately measured should thus be determined & then, whatever uncertainty there may be as to the daily earnings which will attract labourers, there will be little or none as to the quantity of work which should be expected from a given number of men.

11 When the time comes for the commencement of the dam across the river & of the cutting through the ridge, the bulk of the labour will be concentrated in two Camps, one near the ridge, and the other near the Periyaur. There is such an abundance of long grass, bamboo and jungle wood, & these materials make such excellent & comfortable dwellings that, notwithstanding some draw-backs, the huts for the

the coolies should, I think, be therewith made. To prevent however extensive confla-gration, the huts should be in groups of not more than 4 to 6 sheds at one place: the cooking place for each group should be at some little distance, & its walls should be of wattle & dab and the side of the roof over the fires should be lined with a bamboo mat plastered with mud. The provision of latrines (earth trenches) should be looked to, and the sites should be filled in from time to time and other ground should be taken up. Strict discipline will be ne-cessary, and must be steadily enforced in all the camps, and all the arrangements should be carried out according to rule.

12 With regard to the provision of labour for the works, the plan which, I think, will probably work best is to make use of the more intelligent of the coolies who have worked during the last two seasons

to

to collect whatever labour may be required in gangs of from 30 to 40 each. The man thus collecting the labour would be the maistry of the gang, and he might receive 3 pies or 2½ pies per head as remuneration for the number of coolies of the 1st or 2nd class, respectively, brought to, and maintained on, the works by him. Each gang should then have its own huts, and the maistry would be looked to to see that all orders, whether relating to discipline or work were carried out, and the supervising officers would be relieved of much trouble by having only one man instead of 30 or 40 to deal with. Some inducement would have to be offered to coolies in the first place to come up, and perhaps 5 days pay on arrival, to compensate for the expenses of the journey &c., would suffice. Each cooly maistry should be provided with printed Memoranda of the terms or rates he would be empowered to offer. It is intended that all money earned by the gang should be paid to the Maistry. This should be done

In addition to
Huts
Cumblies
Commissariat arrangements so as to prevent grain becoming unfairly expensive.

in

in the presence of as many of the gang as might choose to attend, and as the Maistry would inevitably take some percentage out of it, the gang should have a remedy by having the option of deposing him, if he failed to distribute the earnings fairly.

13 I have touched upon the above details because upon them, or upon efficient substitutes for the arrangements sketched out, will depend in a great measure the progress and the cost of the work, and whatever system may be adopted should be prepared in detail before hand, so that there may be no waste of time or money.

14. The information gained during the recent visit to the Periyaur has convinced me of the importance of the use of water, for the excavation, transport, and deposit of soil for an earthen bund, to the greatest extent practicable. The circumstances are not as favourable as I could wish for the silting process, for on the right bank there is no soil on

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a high level close to the bund site; the only considerable streams of water falling into the Peryaur above the site are cut off by a deep ravine, requiring a very long channel to turn it, or a lofty aqueduct to carry water across in a more direct line. I think nevertheless a small supply may be obtained from the ravine, & that this may be supplemented to some extent from the Chinna Muliyaur or Suruelaur. Four or five miles to the west of the Peryaur Camp the Nel-liccumputty stream will afford an excellent supply, and it may possibly be brought to the work on a higher level than those from the North Eastward. Lieutenant Pennycuick thinks that some water may be got on the left bank of the Peryaur about 2 or 3 miles above the bund site and, if so, this will be a great advantage, especially if it can be carried on a high level, for the hills on that side reach a great elevation, and water on a high level there could be used at a great advantage. It seems probable also that streams will be found round the hills to the South West,

and

and I have asked Lieutenant Pennycuick to explore in that direction. If possible 20 to 25 cubic feet a second should be arranged for, and if this quantity can be obtained from various sources, even though the levels of the greater part should be lower than would be convenient a very satisfactory progress will be ensured. All likely streams should be gauged, so that the amount of work which they may be expected to do may be determined. There is plenty of soil on the hills on all sides, and water will excavate all which can be conveniently commanded by the silting streams: the rest will have to be done in the ordinary manner, though it may be hoped that at least the lower half of the bund will be found capable of being silted in. Should this not prove to be the case at the present site, it may be advisable to adopt another position, if one more favourably circumstanced can be found; or, on the other hand, it may be found necessary to abandon the idea of an earthen dam, and to substitute one of masonry, except for

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for the flanks, and in that case a site lower down the river, where the bed is peculiarly favourable for such a work, would in all probability be chosen.

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15 Some reasons in favour of a high normal lake level have already been adduced. There is however another one, and that is that the execution of the ridge cutting, with its sill lower than the junction of the Chinna Mudiyaur & Suruélaur would be very difficult, owing to the considerable quantity of water which the former always contains: above that point there is only a comparatively small stream, the Suruélaur, and this can be diverted above the side of the cutting, and indeed the water may be carried to the ravine near the bund site, and thence to the bund. The 150 feet level for the lake will answer very well as regards this requirement, and indeed anything above 130 would avoid this difficulty.

16 It will be necessary to construct a regulating sluice at the cutting to restrict the discharge into the Sooroolyaur to a certain maxi-x-mum, as also to allow of the regulation of the discharge when

x 7,50,000 Cyds an hour was the quantity fixed by Captain Ryves, but it is possible that this may need modification

when that river is in heavy fresh from the drainage of its own catchment basin. The regulating work will be simple, and its cost trifling. This arrangement appears to me preferable to that of a regulating reservoir below the cut, because at the reservoir a regulating sluice would be equally necessary, and it will be simpler & less expensive to allow only the maximum arranged for to pass through the ridge cutting, while it will be equally easy to provide at the latter for the diminution of the supply whenever the Soorooly may be in flood.

17 This is the first season during which the discharge of the Periyaur has been gauged, and the result has been to show a much smaller discharge than was anticipated by Captain Ryves, who had nothing but the recorded rainfall at certain stations at a considerable distance, on which to base an estimate. It is supposed that the rainfall on the basin of the Periyaur has been less than usual, and whether this be the case can be indirectly ascertained by obtaining information of the actual

actual rainfall of the year at the several stations mentioned by Captain Ryves, and comparing the record with the averages which he gives. The differences between the assumed discharge in each month and the actual discharge of this season are shown below

	Captain Ryves Estimate millions of c. yards	As gauged 1869 millions c yards
July	170.00	89.672
August	120.00	102.066
September	80.00	67.424

18 The work in the shape of investigation remaining to be done on the hills is as follows. — Lieutenant Pennycuick and Lieutenants Christie & Greer will, it is expected, be able to complete this work by the end of this season, i.e. by the middle of February next.

1st The completion of the examination of the second (168) saddle, so as to ascertain accurately the position of solid rock. At the first saddle (109.64), it is not worthwhile to incur any further expense, as the rock is there on too low a level for the saddle to be used as the site of either a permanent or temporary escape.

2nd The lie of the rock at the bund site should be

be accurately ascertained, and more particularly so on the right bank, as there the culvert will have to be constructed if this site be adhered to. At the same time the distance to which the river deposit on this side extends will be ascertained, and the quantity of soil to be removed, in order to make a water tight junction between the hill and the bund, can then be calculated.

3rd The composition of the small saddle at about 200 on the left bank has to be examined, in order to see whether an escape can there be economically constructed.

4th The examination of the ground from which suitable soil will be obtainable should be continued, with especial reference to the requirements of the upper half of the bund. It may here be mentioned that, should the formation of an earthen bund, without the aid of water, ever be attempted, tramways will have to be laid down, & the work must then be so laid out that the trams for successive vertical portions of the dam may find soil so far above the level of the work under execution as to admit of an incline towards

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the bund. Also, should the lower part of the bund only be formed by silting, conveniently situated soil should be reserved for the upper part.

5th The survey of the Periyaur has to be continued westwards, i.e. down the river, as far as the junction of the Nellicumputty Tavalum stream. A full cross section of the river & of the ground on either side is required at the spur (right bank) about 1½ miles from the Periyaur Camp, which is just at the western extremity of Major Payne's survey. Cross sections should likewise be taken at any other points at which the hills may be found to be in any degree favourable for a bund site.

6th A gauge is required immediately above the first rapid below the Periyaur Camp, and the level of the bed there, with reference to datum, having been ascertained, the water level &c. in freshes of various heights should be compared with the gauge near the Camp. —

7th The country to the north of the Periyaur, West of Major Payne's survey, and East of the Nellicumputty stream requires to be surveyed, and

and the levels of the hills & saddles &c fixed.

8th The Nellicumputty stream should be surveyed, and it should be ascertained on what line, and at what level, its waters can be brought to the bund site. When work in this direction is going on a small camp should be formed at the Tavalum, where there is a considerable clearing. –

9th The survey of the Periyaur above the bund site, which is now in progress, will bring to notice all the streams falling in on the left bank, and these should be explored, so that it may be known how far they can be utilized

10th The country on the left Bank of the Periyaur behind the hills to the South West should be examined. There, in all probability (the atlas sheet is here incomplete), some streams will be found, and, as the hills are high & continuous, possibly a high level supply may thence be obtained. –

11th The several streams, which it may appear to be feasible to bring to the bund, should be gauged by making the discharge pass over planks with notches. Thus for the Nellicumputty stream

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the plank should have an opening of 4 feet by 2 feet with a clear overfall. —

12. The nature of the rock in various localities near the bund site should be ascertained, so that the best place for quarries may be determined.

13. The various arrangements necessary for conveying stone and earth to the work should be put on paper. —

14. There is still a good deal of work to be done in surveying and levelling the Periyaur and its tributaries above the bund site. The cross sections for determining the water spread & contents, at various levels, may in the first instance be at about 1 mile intervals, unless special circumstances should make more frequent sections advisable. It will be better to have complete levels at rather wide intervals, than more detailed information for only a part of the basin.

15. Permanent bench marks should not be lost sight of. These should be carefully selected or constructed, shown, and numbered on the survey, & fully described in notes on the margin of the plans. Pegs have hitherto been largely used as bench

marks

marks; but much more permanent marks are required, & there are plenty of rocks which may be readily made use of, and so marked with a chisel as to be at once recognized.

19 No traces of lime have been found on the hills, and it is probable therefore that this material will have to be obtained from the Cumbum valley, where it is tolerably abundant. The nearest position from whence good nodular limestone can be obtained has yet to be ascertained, and afterwards the exact character of the lime must be investigated, as also its behaviour when mixed with the various clays obtainable near the Periyaur, and with which it will probably have to be incorporated in order to obtain good hydraulic mortar.

20. The road work has made good progress. The 6 feet trace has been cut from the foot of the hills over the crest, & thence to within a short distance of the Periyaur Camp: 2200 yards of the trace have been widened to 18 feet, the full dimensions. A trace 30 feet wide has also been cut from the foot of the hills to Goodaloor. With the exception of a short length at a gradient of 1 in

in 14, the ruling gradient is 1 in 15. The line is generally an excellent one. The deep ravine near the Periyaur Camp has necessitated the carrying of the trace far to the Westward, in order to keep the road on a high level. I think however that it will be advisable to make another & more direct line from the point where the ascending gradient, to carry the line over the saddle at the Hospital hill, commences, and thence to run a descending trace to cross the ravine by a timber (piers & superstructure) bridge. This line will be much shorter, and it will probably be of use for 3 or 4 seasons, during which the cartage of lime will be almost if not quite completed.

21 It does not appear to be advisable at present to continue the widening of the 6 feet trace. To do this will cost a great deal of money, & there is no probability of this communication ever carrying any traffic but that connected with the Periyaur project works, which should therefore bear the cost. The trace will therefore be quite sufficient as a preliminary work; and if the rocks, which here and there obstruct the path be blasted out, much

greater

greater facilities, than at present exist for the transport of supplies, will at once be provided. The only other work at present needed is the construction of catch drains above the roadway to preserve the work already done.

22 Lt. Coaker has left the hills for the purpose of prosecuting the investigations connected with the distribution of the Periyaur water supply in the low Country. Considerable care will be required in dealing with the Sooroly irrigation. There are 13 anicuts across this river; some of them excellent though irregular works, others which would require a considerable outlay to make them secure. None of them irrigate on both sides of the river, and some 2 or 3 are so close to others that it will be advisable to do away with several, and to bring the irrigation under the higher dams. Before the requisite arrangements can be designed, it is essential that reliable information, as to the present water supply at each anicut & in each channel, should be obtained and, as far as I have been able to find out, no registers have as yet been kept. This mission should

therefore

15 20

therefore be remedied as early as possible.

23. On the admission of the Periyaur supply the water level at each anicut will be raised considerably, the exact increase of head depending upon the length of each dam. The crests of the anicuts are at present of uneven level, and the proper course appears to me to be to rearrange them, so as to give as nearly as possible the same depth at the head of the channel with the minimum supply from the Periyaur (during the season of irrigation), the crests being made on a dead level from end to end. These channels will then never get less water than they do at present. To prevent however their receiving a greatly increased supply, and to guard against damage, it will be necessary to provide all the channels connected with these anicuts with head sluices, & these regulating works should have a width of opening equal to the mean width of the channels, & a height of vent sufficient to pass the maximum supply now carried by the channels below the surplus works, with which many of them are provided near their heads. Rules for the

the regulation of the sluices will have to be drawn up after the particulars of the present supply of the channels shall have been ascertained, & after the necessary modifications of the anicuts have been determined. The arrangements should be fixed on a scale sufficiently liberal to prevent any just cause of complaint on the part of the ryots interested, who have exhibited a commendable industry in the preparation of their lands for wet cultivation, & brought that cultivation in several places to a high state of efficiency. All the anicuts which it may be decided to retain should have carefully fitted stone copings, and they should be otherwise strengthened where necessary, as the wear and tear, which they will have to stand, will be very much greater when freshes from the Periyaur come to be & passed over them in considerable volume, and during long periods.

24. The Peranny & the Chittany on the Vygai are both admirable works, the former apparently of entirely native design, while the latter

latter would seem, from its having an ogee fall, to have been modified under European superintendence. Both require some little repair, the first to the crest, where of brickwork, & to the apron, which is a good deal displaced; the second needs the replacement of a few of the stones on the rear slope (ogee), the repacking of the rough stone apron, & some additional rough stone round the cutstone apron of the undersluices.

25. The general sketch of the proposed irrigation from the Vygai given in Captain Ryves' letter of the 7th August 1867 appears to be sufficient for the present as a guide to Lt. Coaker in working out the details of the distribution channels required. Enough has not been done at present to enable an opinion to be formed of the probable cost of the works, and it may be doubted whether the investigation will be complete much before July 1870, as, until February, the officers on the hills will not be available to assist in pushing them forward. In the general sketch plan, the channels are shown going into, and out of, the several Tanks in succession. This arrangement should not be

resorted

resorted to unless circumstances render it unavoid-
-able. It is bad for the Tanks, & it is unfair
to the cultivators under the lower parts of the chan-
-nels, who are unable to get water, however much
their crops may be in need of it, until all the
Tanks above have been filled. Where this system
has to be adopted the Tanks should have low
level sluices for the special purpose of passing
on a portion of the supply

Madura W. Hutchins Major R.E.
28 October 69 Acting Chief Engineer for Irrigation

To

The Secretary to
Government P.W. D.

P. W. 1869 Dept
Proc. of Govt. for November
No. 4040

From
The Actg. Chief Engr.
for Irrigation

To
The Secretary
to Govt. P. W. D.

Dated 28th October 1869.
Despd. 3rd Novr. "
Recd. 4th "
No. 289.
Enclo. 2. 1 Plan

Note on the Penyaur Project after a visit to the site.

No. 3763 - 26 = Novr. /69.

No. 530
C. 10th Novr. 1869 R. 15th

No. 56.

Memorandum

on work executed in Connection with the Periar Project, upto 30th September 1869.

A six foot path has been cut from the watershed to a distance of 4¼ miles towards Cumbum, and of about 2¼ towards the Periar. For a mile and a half of this distance the earthwork has been Completed to the full width of 18 feet.

2. A portion of the basin of the lake has been surveyed.

3. The health of the workmen Continues good, and there has been no difficulty with regard to the supply of labour.

4. The rainfall during the month has been 5.47 inches and 6.24 inches at the two Camps, and the total discharge

of the river during the month has been 67.424 millions of Cubic yards, giving a depth run off from the whole drainage area of 3.13 inches. These figures are somewhat less than Captain Ryves' estimate.* A table and diagram of rainfall, river level and discharge are enclosed.

* Rainfall — Inches 6.03
Discharge of river 80 millions Cubic yards
Depth run off. 3.72 inches.

Camp Periar
2 October 1869
(Signed) J. Pennycuick Lieut. R.E.
Executive Engineer on Special Duty

Copy

No. 1648

Forwarded to the Chief Engineer for Irrigation

Enc 1
1 Diagram

[signature] Captn. R.E.
Offg Superintg Engineer 8 Dn

Chunnamanur
18 October 1869.

No. 828.

From.

The Offg Supg Engr.
8th Divn.

To. The Ag Chief Engr.
for Irrigation

Dated. 18 October 1869
Received 2nd Nov. " "

My. 21/10

P.W.S. 47/69

Forwards Copy of Lieutt Pennycuicks Memorandum on work executed in connection with the Periar project up to 30th September 1869

Proo 26 Novr 69 No 2530

Public Works Department
No. 3763

Proceedings of the Madras Government

Under date the 26th Nov. /64

Read the following

From. The Ag. Chief Engineer for Irrigation } I.E. No. 289. d/28th October 1864

From this report the Government are disappointed to learn that much has still to be done for the collection of information before properly complete plans and estimates can be prepared for the Perriyaur diversion project. Four Officers of Engineers, ~~[illegible]~~ ~~[illegible]~~ are

N.

WD

AJA

I read with this - Their services in my opinion could be better employed N.

are occupied on the investigations and the Government were in hopes that these investigations had been so far advanced as to have allowed of the scheme being put into shape for transmission to the Government of India in time for an allotment to be made for the work in the outgoing Budget. This, it is now clear, cannot be done, and the work

it

it is feared, will have to be delayed another year.

The work still requiring to be done above the Ghaut is.

1st. The fixing of the situation of the escape.

2nd. The determination of the level and exact lie of the rock in the bed of the river at the site of the proposed dam.

3rd. The ascertaining from whence suitable soil for the dam may be obtained, both with a view to the employment of the silting process, and with reference to the requirements of the upper half of the bund in the event of silting being only partially

available.

4th. The completion of the Survey of the river, with cross sections at proper intervals, and a final examination of the locality for the most favorable site. Also a Survey of the Country north of the Perryar and east of the Nelli: cumpully stream for the purpose of fixing the levels of the hills and saddles, and determining the line by which the Nellicum: putty stream may be brought to the site of the bund.

5th. The examination of all the streams falling into the Perryaur on either bank, and the guaging

of those which it may appear to be feasible to bring to the bund for silting purposes.

6th An examination of the nature of the rock in various places near the proposed bund, and the settlement of arrangements for the transport of stone and earth to the work.

Lieutenants Pennycuick, Greer, and Christie will, it is expected, be able to complete this work by the end of February when the hills must be temporarily evacuated. There is a good deal to be done in the low Country in surveying and levelling and in

prosecuting investigations
connected with the
measures that will re
:quire to be adopted
in rearranging the
system of irrigation
both under the Sroolyar
and the Vigay to utilize
the increased supply
of water, which will be
available on the diversion
into these streams of
the Perryaur but Lieut
Coaker is actively
engaged on the work, and
with the assistance of
the other Officers after
February, Major Mullins

expects that about July next, sufficient will have been done to allow of a fair estimate being made out of the probable cost of the project.

The Government look with much in:terest, to the fulfilment of these anticipations.

They agree with Major Mullins in his remarks on the high rate for the Ghat work which Lieut. Pennycuick has been paying, and they concur in thinking that with the better acquaintance the people will have formed with the country within the

hills in consequence of the opening of the Ghat, the dread in which the locality is held will be greatly removed, and that it is not only possible but likely that labor will be obtainable at a rate considerably lower than that which it has been necessary hitherto to pay to attract workmen. For the present it does not appear to be necessary to complete the widening of the road trace beyond the 6 feet width to which it has been

27 ~~21~~ 282

~~completed~~ opened from the foot of the hills over the crest and to near the Perryam camp. The Government have at present no funds at their disposal for this road, but it is under consideration in the Revenue Department whether an advance for the purpose may not be made from the Local funds of the District.

W.E.

30/13

To The S. Engr. 8: Dn. /
" Ch: Engr. for Irr: /
" Revenue Dept. /

Despd. 30/11/69-

A copy of this furnished to the Hon: A. J. Arbuthnot 20/11/69.

~~complete~~ [illegible] from the foot of the hills over the new road to near the European quarter. The Government have at present no guards at this Hospital for this purpose, but it is under consideration in the Revenue Department whether an advance for the purpose may not be made from the Local funds of the District.

Cue4640

Govt. of {1869} Madras.

PUBLIC WORKS.

To The Superintending Engr.
8th. Division

Dated

Recd. Encl. 2

G. O. 26 Nov. 1869, No. 3763

Nos. 530-531

Perryaur diversion project

Passing orders on the Report of the Chief Engr for Irrigation on the Perryaur diversion project in the Madura Dt.

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